EFFECTS OF NOISE ON READING COMPREHENSION IN CHILDREN

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AN INDEPENDENT PROJECT

SUBMITTED IN PART FULFILLMENT OF FIRST YEAR M.Sc.

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C E R T I F I C A T E

This is to certify that the Independent Project entitled **"EFFECTS OF NOISE ON READING COMPRE-HENSION IN CHILDREN"** is the bonafide work done in part fulfillment of M.Sc., First Year (Speech and Hearing) of the student with Register No.

DIRECTOR

Mysore.

Date:APR.30th.1983.

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CERTIFICATE

This is to certify that the Independent Project entitled **"EFFECTS OF NOISE ON READING COMPREHENSION IN CHILDREN"** was done under my supervision and guidance.

Mysore.

Date: APR 30th

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D E C L A R A T I O N

This Independent Project work is the result of my own study undertaken under the guidance of Dr.(Miss.) S. Nikam, Professor & Head of the Department of Audiology, All India Institute of Speech and Hearing, Mysore, and has not been submitted earlier at any University for any other Diploma or Degree.

Mysore,
Date: Register No.

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C O N T E N T S

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CHAPTER - I

INTRODUCTION

An old riddle asked, "What comes with a carriage and goes with a carriage, is of no use to the carriage and yet cannot move without it?" The answer: "A noise".

Sound is of great value to man. It warns him of impending danger. Also, it appropriately activates him. The unique advantage of speech and language is made available to man because of sounds.

Unfortunately, excess of sound irrelavant to the individual can arouse him too much and with no adaptive advantage. Also, excess of sound can interfere with the perception of important, relevant auditory signals. Over exposure to sounds can cause the ear to temporarily and sometimes permanently suffer a loss of function. Thus, irrelevant or excessive sound is undesirable. Such unwanted sound is "noise".

Noise can have adverse effects on man. It can permanently damage the inner ear resulting in permanent hearing loss, also called as noise induced permanent threshold shift (NIPTS). It can also result in temporary hearing loss or temporary threshold shift (TTS).

Losses in hearing sensitivity, both temporary and permanent, together with the masking of speech and other desired sounds, constitute the most significant sensation and perception problems posed by noise (Kryter, 1970). Noise induced hearing loss is believed to be a major health hazard in industry (Hosey, 1967).

Other adverse effects of noise on man's behavior and subjective experience include losses in work capacity, disruption of rest and sleep, annoyance reactions and general mental distress (Cohen, 1969).

The physiological responses to noise include the responses of voluntary muscles, peripheral vaso-constriction, audiogenic seizures, responses of smooth muscles and glands, neuroendocrine responses, inter-ference with sexual reproductive functions, responses of fetus to noise, resistance to disease, and hypertrophy of adrenal glands. (Kryter, 1970? Welch and Welch, 1970; Kryter and Poza, 1980).

There have been a number of studies which attempted to show the detrimental effects of noise on mental, motor and psychomotor abilities in adults. Tne effects of noise on complex psychomotor task (Key and Payne, 1981), motor tasks (Cohen et al. 1966), target-detection (Warner and Heimstra, 1978), Vigilance performance (Cohen et al. 1966; Benigus et al. 1975), various versions of stroop color interference tests (Hartley and Adams, 1974; O'Malley and Callus, 1977; Ogden et al. 1979), mental tasks (Cohen et al. 1966; Finkleman and Glass, 1970) and time estimation (Rai, 1975) have been investigated. The other effects of noise on psychological functions of attention (Forster and Grierson, 1978) aggressive behavior (Donerstein and Wilson, 1976) and helping behavior (Mathews and Canon, 1975) have also been studied.

Most of the information available on the effects of noise on people are from the studies on adults. Effects of noise have also been studied in children, though not as extensively as in adults. Effects of noise on hearing sensitivity (Fior, 1972; Roche et al. 1978; Siervogel et al. 1982), speech discrimination (Larson and Peterson, 1978; Glenn et al. 1978; Elliott, 1979; Elliott, Kalikow and Stevens 1979; Smyth, 1979; Houtgast, 1981), academic achievement (Lane and Meecham, 1974; Ko et al. 1981), arithmetic skills, (Kassinove, 1972; Ishikawa and Aoki, 1974), reading comprehension (Slater, 1968) in children have been investigated. Other aspects studied in children are, effects of noise on sleep (Ando and Hattori, 1977; Theissen, 1978) and on noise tolerance (Elliott, 1971).

The results of these studies have sometimes shown losses, sometimes improvement or sometime no significant changes in task performance when compared to the performance under no noise conditions and hence are equivocal. However, the differences in results are, in part, due to the type and amount of noise used, the complexity of tasks involved, differences in the methodology and the techniques of analysis used.

Need for the study:

The results of studies on the effects of noise on scholastic performance in children have been equivocal. There appears to be only one study (Slater, 1968) which investigated the effects of noise on a written task, requiring reading comprehension. The results of her study did not show any significant effect of noise on a written task in children.

However, the results outlined by Slater (1968) cannot be directly applied to the performance of Indian children in the presence of noise. The reasons for this being, one, Indian children study in schools wherein the number of students in a class are more and hence the noise levels could be relatively higher compared to the western set up. In addition, the noise levels at home may be high because of greater incidence of joint family system in India. Having been exposed to high noise levels constantly, Indian children might be adapted to signals such as speech babble. Therefore, the performance of these children under a noise condition might not be adversely affected.

On the other hand, it is also possible that the Indian children could be more adversely affected by the presence of noise as they often study in schools which may employ a non-native or foreign language as the medium of instruction. For example, children with Kannada as mother tongue may study in English medium. In such a situation a child not only has to comprehend a non-native language but also has to cope up with the difficulties posed by the presence of noise.

It is therefore, necessary to investigate whether the children are adapted to the noise or whether they are adversely affected by the presence of noise while reading a passage in a non-native language.

Summary and statement of the problem:

Loud noise has adverse effects on man. It may affect the auditory sensitivity temporarily or permanently. It is also found to affect the physiological functions in man. The performance of motor and mental task could also be affected in the presence of noise. The studies on various effects of noise have been conducted mainly on adults.

The presence of noise may affect the performance of children on different tasks which may have a bearing on the scholastic performance, such as, reading. Studies regarding the reading comprehension in the presence of noise are few and such measures are of importance as reading skills in children are essential in academic achievement and other learning activities.

The effect of noise on reading comprehension has not been investigated among Indian children. The present study undertook to investigate the effects of noise on reading comprehension in children aged, 9-12 years who were non-native speakers of English. The subjects in the study were native speakers of Kannada and their reading comprehension was tested in English under two conditions namely; quiet and noise.

The study aimed at answering the following questioner.

1. Does the presence of noise significantly affect the reading comprehension in children?

2. Is there a significant effect of age on reading comprehension in quiet and in the presence of noise?

3. Do age and noise interact to affect the reading comprehension significantly?

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CHAPTER - II

REVIEW OF LITERATURE

Noise has various hazardous effects on man. The most important one being the decrease in auditory sensitivity.

Effects of noise on auditory sensitivity:

Frequent exposure to noise of high intensity for sufficiently long duration could injure the inner ear and produce a hearing loss. The injury and hearing loss could be temporary, lasting for minutes, hours or days after the termination of the exposure or it could be permanent, lasting for the remainder of the life of the individual. Also, the hearing losses could range from slight impairment to total deafness (Miller, 1974).

For a number of reasons, the facts related to noise induced hearing loss in adults could entirely or partially be inapplicable to infants and children. Adults and children are different with respect to the dimensions and configuration of the head. Transmission of sounds from the external ear to the tympanic membrane and there to the inner ear also are different (Mills, 1975).

A number of devices used directly or indirectly by children have levels which are capable of producing an acoustic injury to the adult ear and temporary or permanent hearing losses. These probably could produce hearing loss in children (Mills, 1975).

Devices with notably high sound levels include snow mobiles (Bess and Poynor, 1972; Chaney, McClain and Harrison, 1973), real and toy fire arms (Hodge and McCommons, 1966; Gjaevenes, 1966; Marshall and Brandt, 1974), incubators (Peltzman et al. 1970; Falk and Farmer, 1973); fire crackers and others. Short impulsive sounds like fire crackers can produce a large permanent hearing loss. Also, exposure for longer duration to the noises made by devices which produce moderate levels of noise create a risk of hearing loss and injury to the ear. For instance, all day outings on snow mobiles or placement of premature and unhealthy babies for weeks in incubators and pressure boxes are a great risk for hearing loss.

Fior (1972) reported that children between the ages of 3 and 13 years incur TTS. The magnitude of TTS did not substantially differ from those incurred by adults exposed to identical noise conditions.

Mills (1975) reviewing the studies on TTS concluded that it was not clear whether children were more than, less than or about equally affected as adults and that the differential susceptibility of children to TTS is an open issue.

Studies on puretone sensitivity in children across different ages have shown decrement in hearing sensitivity with increasing age and this could probably be related to the exposure of noise in daily life.

Eagles, et al. (1963) reported the data on 4078 school children aged between 5 and 14 years. The patterns of hearing levels showed that 75% of all children had hearing sensitivity better than audiometric zero, with most sensitive hearing at 250 Hz and least sensitive at 6000 Hz. Also, girls' hearing sensitivity was 2 dB better than that of the boys. The data showed that hearing sensitivity increased from age 5 to about 12-13 years and dropped at about 14-15 years.

Litke (1971) reported elevated hearing thresholds at high frequency in children. Audiograms of ninety one children in Kindergarten through twelfth grade were studied. High frequency threshold elevation/was observed in 6% of the population. The results showed that the correlation between incidence of high-frequency threshold elevation and grade level was statistically significant. Also, 6000 Hz was most often affected frequency in about two-thirds of subjects. Boys showed high-frequency threshold elevation about five times more than girls.

Noise induced hearing loss is generally centered at or around 4000 Hz and 6000 Hz (Maas, 1972). Lower hearing sensitivity at 6000 Hz in children as noted by Eagles et al. (1963) and Litke (1971) could be attributed to the exposure to noise in everyday life situation.

Roche et al. (1978) reported a longitudinal study on hearing in children. Serial auditory thresh-olds, were recorded at six month intervals from 224 children and youth aged 4 to 18 years. The data obtained during the first year showed that girls had lower hearing thresholds than boys, especially in the age range of 12 to 17 years. Children aged 12 to 17 years had lower hearing thresholds than did those between 6 to 11 years in both the sexes. Total noise exposure scores, as obtained by questionnaires, tended to be higher in boys than girls, especially after 10 years of age. But these scores were not found to be significantly correlated with auditory threshold levels. The incidence of exposure to events associated with noise, increased markedly in teenage boys and was related to auditory threshold levels. Associations between auditory threshold levels and responses to general health questions or attained stature were not significant. However, associations with meatal abnormalities were found. Also, rapid maturation in girls was evidenced to be assoiated with lower threshold levels especially for lower frequencies. The authors opined that the effects of hearing loss may be more serious for a child than adult because of possible learning disability.

Siervogel et al (1982) made noise measurements using dosemeters to record sound levels encountered by 127 children and youth aged 7.0 to 20.2 years (these children were a subset of subjects employed by Roche et al. 1978). The data indicated that there were no significant age effects in noise exposure, but small sex differences were found, with boys having slightly greater noise exposure than girls. Also, the data provided a strong evidence that noise exposure in children is substantial.

Speech discrimination in noise:

Man has an ability to "hear out" one sound from a background of other sounds. Unwanted sounds, noises, however, can interfere with the perception of wanted sounds and signals. This is called 'masking'. By masking, an auditory signal can be made inaudible or the quality of the signals can be changed, its apparent location or distinctiveness can be changed (Kryter, 1970; Jeffress, 1970; Scharf, 1970). Speech understanding, which is important for everyday life, might get affected by the presence of noise. Thus, noise of certain levels interferes with intelligibility or discriminability of speech speech signals.

Those who work in high levels of background noise claim that they 'get used to it'. However, evidence is that they adopt a 'non-communating life-style' and increase their use of non-verbal communication through gestures, posture and facial expression (Kryter, 1970). Among adults, free and easy speech communication is probably essential for full development of social relation and self (Miller, 1974).

For very young children there might be other additional problems. They gradually induce their knowledge of language and its subtleties from the speech to which they are exposed. Because their language is still developing, children probably have more difficulty understanding speech in noise than do adults. Because noise can reduce the amount of speech used at home, in the yard or on the playground and because noise can make speech difficult to understand; it is possible that language development of early childhood might Be adversely affected. From this difficulty in learning to read may ensue. Later school-age children probably encounter more difficulty in noisy classroom. (Miller, 19743.

Children require greater signal-to-noise ratios than adults to achieve the same performance levels in clinical tests of speech perception. In the Goldman-Fristoe-Woodcock test of auditory discrimination (1970, from Willeford and Billger, 1978) performance improved from about 4 years, where the normative data starts, to about 25 years of age and thereafter it declined. The performance of children of about 10 years and younger is more affected by the presence of a competing noise (Cafteria noise, and monosyllabic words, with S/N 9 dB) than that of the older children and adults, even 68 and 86 year old adults.

A number of variables affect the performance on tests of speech perception, like context, S/N ratio, type of speech material used, type of competing message, reverberation and others.

Mills (1975) concluded that "levels of noise that do not interfere with the perception of speech by adults may interfere significantly with the perception of speech by children ...." He also stated that "a comprehensive assessment of the effects of noise on children is limited not only by the absence of direct information, but also by the absence of data on development of auditory perceptual skills and the absence of suitable instruments for assessing those skills." (pp.776)

Speech intelligibility and speech understanding in children have been studied in the laboratory situation. One kind of noise that is often encountered is a babble of voices produced by several speakers. It has been shown that this type of noise interferes with speech intelligibility more than a (stationary) random nonspeech noise, and that the amount of masking depends upon the number of different voices that are mixed to produce the noise (Carhart, Tillman and Greetis, 1969). This was referred to as "perceptual masking" and this effect increased as the number of talkers in the babble increased from one to three and then declined slowly to about 3dB for a large number of talkers. This enhanced intereference arised both because the babble contains false speech cues and it increases the load on the attention and memory processes that are involved in understanding sentences.

Adverse effects of noise on speech understanding has been studied using SPIN test procedure. Kalikow, Stevens and Elliott (1977) developed the test "Speech perception in noise" (SPIN) to assess "everyday" speech reception in English speaking adults. This, in addition to measuring word intelligibility measured a cognitive component of speech understanding in that two different scores were derived - one for 'high predictability' (HP) sentences that contained two or three pointer words that provide links to the keywords and one for 'low predictability' (LP) sentences that contained no semantic clues. These sentences were presented in babble type of noise and the listener response was the final word in the sentence which was always a monosyllabic noun. Kalikow, Stevens and Elliott (1977) hypothesized that the difference between the HP and LP scores would provide information to the absolute values of the scores. This difference was expected to be especially useful when using SPIN to evaluate older hearing impaired adults who may have central auditory processing abnormalities as well as those with presbycusis. Priliminary evaluative data obtained by Kalikow, Stevens and Elliott (1977) with the SPIN test showed performance differences between 18 to 25 year old and 60 to 65 year old normal hearing listeners. Though there was difference between the two groups of listeners, it was not great.

Elliott (1979) investigated the speech understanding in children between 9 to 17 years of age using SPIN test procedure. After the practice session, three signal-to-babble ratios were used (-5 dB, 0 dB and + 5 dB S/B levels) for testing, with the level of the babble always being 70 dB SPL. Results showed that the performance of 11 and 13 year olds was significantly poorer than that of 15 and 17 year olds in HP sentences at the 0 S/B level. Performance of 11 year olds was significantly poorer than that of 17 year olds.

Another set of 11 year old children were tested by Elliott (1979) at a 'magnet' school that was judged by teachers and staff as being particularly noisy. Noise levels measured were in the range of 64 to 78 dB A, the levels reaching greater than 80 dBA at times. The performance of these children was better than that of 11 year olds tested previously. The difference in results obtained from the two groups was attributed to sampling differences or experience in listening to speech in the noisy environment.

In the same study (Elliott, 1979), 9 year old and some 11 year old children attending an elementary school were tested. Noise levels of 47 and 48 dBA were found in these schools, which were considerably lower than the levels found in 'magnet' schools. This small group of 11 year olds performed in a manner similar to that observed in the first experimental group. Results showed that the performance of 9 year old children was poorer than 11 year olds tested in laboratory and that the 9 year olds with learning problems performed more poorly than the normally progressing 9 year old children.

Based on these results, Elliott (1979) suggested that SPIN procedure should not be used with listeners younger than 15 years of age. When the data for the children were compared to that obtained from adults, the impact of multi-talker babble was comparitively greater, for 11 and 13 year olds, only for the HP sentences presented at the difficult 0 dB S/N level. Thus, the greater impact of multi-talker babble on HP sentences might not be a direct auditory masking effect.

Elliott (1979) concluded that the HP sentences were more affected either because the babble affects children's (11 and 13 year old) ability to make use of language 'rules' or because they possess less knowledge of those rules. However, 9 year old children performed poorer than the older subjects for all noise conditions, the difference was greatest for the HP sentences at the 0 dB S/B condition. This, according to Elliott (1979), suggested that two diffe-rent factors were operating for the children aged 9 years. The poorer performance on the LP sentences was probably a result of the babble having a greater "masking" effect on the words of the sentences. The extremely poor performance on the HP sentences was probably attributable to the combined effects of, (1) "masking" effect of the babble and, (2) the inability of the children to use the knowledge of laxical and syntactic contingencies or the limited knowledge of language rules of the 9 year olds.

Elliott, Kalikow and Stevens (1979) studied children's understanding of monosyllabic nouns in quiet and in noise. A four-alternative forced choice adaptive procedure was used to measure the lowest intensity at which children could identify mono-syllabic nouns. These words were standardized and were understandable to 3 year old inner city children, at comfortable listening levels. Six different groups of subjects were tested. Four of these groups namely, normal cnildren, children with learning problems, children with developmental articulation problems and adults were tested in school environment. Two other groups namely, normal children and adults were tested in the laboratory. Four experimental tasks were used, quiet open-set (word repetition used as response), quiet closed-set (picture pointing used as response), babble closed-set and filtered-noise closed-set.

The results of the study (Elliott, Kalikow and Stevens, 1979) indicated that children as young as

5 years of age could be successfully tested on the adaptive speech understanding procedure. No developmental changes were found in 'perceptual masking' (Carhart, Tillman and Greetis, 1969) between the ages of 5 years and adulthood. Also, the data clearly indicated developmental changes in speech understanding 'thresholds' in quiet, across the 5 to 10 year age range. By the age of 10 years, the performance of normal children achieved a level that typified adult performance. And this age related change eccured even though the monosyllabic stimuli were well within the receptive vocabulary of 3 year old children. Also, children with learning problems required higher signal intensities than normally progressing children to achieve 71% correct level of performance for the two quiet test conditions. However, this was not attributed to poorer attention span in children with learning problem nor to the hearing loss measured.

Elliott, Kalikow and Stevens (1979) opined that the poorer performance of children with learning difficulties could be attributed to a considerable extent to the less developed language competence in these children. The much diminisned impact of chronological age and problem status on performance under the filtered-noise and babble test conditions suggested that these maskers might have nearly obliterated the cues that the older subjects were able to use more efficiently than younger listeners ie., the task of understanding monosyllabic words may involve acnieving "semantic closure" from partial or limited acoustic information. However, when the acoustic information in the signal is too limited, even listeners with considerable language competance may be unable to utilize their knowledge of language "to fill in the gaps" or they may be unable to accomplish this to the same degree as in the quiet listening conditions.

The practical implications of the above studies are that the children as young as 5 years may understand a spoken word about as well as older children and adults when it occurs in a noisy environment, provided that is a frequently used word which is well within their vocabulary. Monosyllabic words spoken in quiet environment to younger children and children with delayed language skills require a more intense signal to understand the message than a signal level required by older children and adults.

Environmental noise and its effects on acquisition of linguistic skills:

Noise levels in the home environment depend on many factors. House hold appliances, radios, television sets, and a variety of musical instruments determine the noise levels inside the house. The noise levels also depend on the location of the house. Noise from highway or aircraft noise affect the noise levels inside the house (Jensen, 1978).

Intermittent reduction in the loudness of sensory inputs in the presence of noise is sufficient to impede speech and language development. Noise of sufficient intensity does more than reduce the loudness of speech (Kryter, 1970; Miller, 1974). According to speech interference levels required for young, normal hearing adults listening in ideal acoustic environments, sound levels of 60 to 65 dBA often require the speaker to increase the voice level and vocal effort. Levels of 75 dBA often require the talker to shout. Noise of sufficient intensity probably discourages conversation, reduces the content of verbal communication, and may require frequent repetitions of message. These can lead to irritation; confusion and fatigue on the part of the talker and the listener. The extent to which noise poses a threat to the development of speech, language and listening skills depends upon the levels of noise found at home, play groups and schools.

A quantitative approach to the measurement of noise levels in homes and their effect upon developmental functions namely, auditory discrimination and reading, was undertaken by Cohen, glass and Singer (1973). Fiftyfour elementary school children (second to fifth grade) who lived in four 32-floor apartment buildings adjacent to a heavily traveled express-way were tested principally for auditory discrimination (Wepman Auditory Discrimination Test) and reading level. Average sound levels outside the apartments, taken on two successive days, ranged from 76 to 79 dBA (modal value). Average A-weighted round levels directly overlooking the express way recorded over two days ranged from 83 to 84 dBA. Levels measured at hall-way windows overlooking the express-way (windows closed) were inversely related to floor levels as follows: 55 dBA on the 32nd floor; 58 dBA on the 26th floor; 60 dBA on the 20th floor; 63 dBA on the 14th floor; and 66 dBA on the 8th floor, i.e., the sound levels in the hallways decreased about 0.5 dB/floor.

Correlations between scores on the auditory discrimination test and floor level were significant ($r = 0.48$, $P < 0.01$) only for the group of children who had lived in the apartment complex for four years or longer. Thus, exposure to current levels of environmental noise for long periods may affect the auditory discrimination skills in children. Correlations were also significant between auditory discrimination and percentile scores on a reading test ($r = 0.53$, $P < 0.01$), again only for the group who had resided in the apartment complex for at least four years.

Further analysis showed that parental education also played an important role, especially in regard to the reading scores. Noise levels (floor level) skill emerged as the most significantly variable. The investigators (Cohen, Glass and Singer, 1973) had excluded the hearing loss and carbon monoxide level factors.

Cohen, Glass and Singer (1973) offered two major conclusions:

1. Noise levels could account for a significant percent of the variance in auditory discrimination.

2. Auditory discrimination could account for a significant percent of variance in reading achievement.

Cohen, Glass and Singer (1973) speculated that a child could become inattentive to acoustic cues as he attempts repeatedly to cope with unwanted sounds i.e., the longer he must endure noise, the more likely that he would ignore all sounds, whether relevant or not. A consequence would be a failure to learn to discriminate speech relevant cues at a time which might be optimal for such learning. Deficits in auditory discrimination would reflect this problem and should become increasingly evident with longer periods of noise exposure. This study demonstrated post-noise consequences in a real-life setting supplementing laboratory research which showed the stressful impact of noise on behavior.

Classroom noise and its effects on scholastic permance:

Noise levels in schools could be less than optimum. Neimoeller (1968) advocated classroom sound levels of 30 to 35 dBA in schools for the deaf.

While such levels might be adequate for clinical use, it is unlikely to be achieved in average normal classroom. Noise levels in normal schools have also been prescribed. The Japnese Ministry of Education has designed a maximum level of 55 dBA as the environmental standard for schools. In the U.S., a realistic goal is a background level not exceeding 65 dBA (Nabelek and Nabelek, 1978).

Paul (1967, cited in Smyth, 1979) measured the noise levels in a number of elementary schools and obtained an average of 63 dBC. Slater (1968) reported the average sound levels of several unoccupied elementary and Kindergarten classrooms to be 58 to 60 dBC. Nober (1973, cited in Mills, 1975) reported that the average sound level of four elementary classrooms was 65 dBA.

The major complaint about open-plan schools is usually the high noise levels with resulting annoyance and distraction that can affect both teachers and students. Noise levels in classrooms keep varying from time to time. The noise level in some schools is reported to be as high as 70 dBA. It was found to be highest in Kindergarten, lower in upper grades and lowest in high schools (Nabelek and Nabelek, 1978).

Often, the noise levels in schools might be higher than the prescribed levels. This might affect the children's performance in schools.

Academic achievement:

The penetration of outdoor noises into school buildings and churches creates serious disturbances and annoyance. Describing this Cohen (1969) quotes: "One school superintendent reported 40 to 60 interruptions perday in classroom listening activities of the three schools lying within 1.5 mile of a major commercial airport. The total number of affected classes yielded a cumulative loss ranging from 700 minutes to 1400 minutes per day of instruction time." (p.75)

Lane and Meccham (1974) made indoor and outdoor measurements of jet aircraft noise at seven schools beneath the paths to the Los Angeles International Airport. The survey indicated that the school yard noise levels from jet aircraft approaching the airport (at an average rate of one in every two minutes) were in the range of 96 to 118 dBC. This constituted a high risk of hearing damage of children. Noise levels measured in the classrooms were in the range of 80-96 dBA. The interruption in classroom by jet noise every two minutes resulted in a serious disruption of the concentration, communications and learning processes necessary for educational activity.

Ko et al. (1981) considered the long-term effect of aircraft noise on the academic performance of pupils. Because of the difficulty involved in devising controlled experiments on the long-term effects of noise, the academic performance of pupils sitting for two public examinations were used priliminarily. The pupils (241 in number) were chosen from schools, and they had been exposed daily to aircraft noise during their full five year period of secondary education. Another group of 256 pupils were chosen from schools located far from the airport and were not subjected to any aircraft noise. The subjects 12 to 17 years in age were matched on the basis of Hong-Kong certificate of Education Examination Performance. The average aircraft peak noise levels at tne schools under the flight path had mean noise levels of 90, 92 and 94 dBA. The comparison of academic performance of the two groups showed no significant difference. Adaptation to aircraft noise by pupils was cited as a possible explanation for the findings.

Ko et al (1981) concluded that, as far as academic performance was considered, factors such as, the intelligence of pupils, the total duration of aircraft flyover and home environment may not he as significant as the ability to adapt to noise.

Speech intelligibility

The signal-to-noise ratio existing between the teacher's voice and the ambient classroom noise should permit the teacher's voice to be heard by children without difficulty. If the acoustical environment of the average class does not facilitate optimal speech reception many children can expected to be affected adversely. In schools, speech intelligibility is essential, school privacy is not critical.

Larson and Peterson (1978) pointed out the problems of noise levels, especially in open-plan classes. They observed that often the signal-to-noise ratio (teacher's voice compared to the background sound) was below that required for understanding speech and that this could affect the children more adversely as they require a greater S/N ratio than adults.

Smyth (1979) tested 300 primary school children aged between 5 and 12 years age for discrimination of simple, familiar, monosyllabic words under two conditions namely, quiet and in the presence of background noise. Recorded word list was presented in classroom via loudspeakers. The average noise level in the empty classroom ranged from 35 dBSPL to 45 dB SPL with some peaks of 65 dB SPL on the B scale. Subjectively, this was considered quiet and the material was presented at 50 dB SPL for all children. For the 'noise' condition, the word list was recorded in tne same classroom during classtime. The average noise level throughout was 72.4 dB SPL, with an S/N level of 3.1 dB. Noise generated within the classroom boundaries ranged from 38 to 90+dB SPL. The average noise was 29.3 dB SPL greater than the resting classroom.

Results of the study (Smyth, 1979) showed that 45.3% made errors in speech reception in the presence of classroom noise. The percentage of children found to make errors in the presence of classroom noise decreased with increasing age. This age effect was most marked in children younger than 7 years 6 months.

According to Smyth (1979), 5% of what is said would always be unmasked speech during active classroom program (as in the noise condition used in the study); 5% would always be marked by background noise and the remaining 90% of speech existed in a favourable S/N level.

Thus, S/N level is more important than absolute noise levels. Smyth's (1979) study indicated that classroom noise competes for the child's attention and forces speech reception which otherwise would not occur. The results suggested that noise levels existing in some open classrooms may be excessive. The noise levels may be increased because of the classroom activities themselves. However, Smyth (1979) has reported that the noise levels used in the study were not perceived as excessive by the classroom teachers concerned.

Houtgast (1981) reported a study in which intelligibility tests were performed by teachers and pupils in classrooms under a variety of noise conditions. Three conditions were used for testing - (1) a reference condition with essentially no effect of reverberation or interfering noise; (ii) classroom conditions with only reverberation and essentially no interfering noise and (iii) classroom condition with both reverberation and interfering (road traffic) noise. The intelligibility scores were found to deteriorate at (indoor) noise levels exceeding a critical value of -15 dBA with regard to a teacher's long-term (reverberent) speech level. Thus, in a typical classroom, reverberation set an upper limit to speech intelligibility and the effect of interfering noise became noticeable at levels exceeding a critical level. Also, data from 999 questionnaires filled out by teachers and the external noise levels measured at the facades of their classrooms were used to relate the degree of bother caused to the equivalent level of road traffic noise. The present data on speech intelligibility in classroom - and more specifically on a critical indoor noise level - were consistent with the opinion of both teachers and experts on the effects from external noise levels.

Thus, the data (Larson and Peterson, 1978; Smyth, 1979; Houtgast, 1981) suggested that the levels of noise measured in schools are capable of interfering with speech communication by children. Also, diversification of activities, and movement of classroom occupants and physical plant therein, has a cumulative effect on the noise levels. The principle of auditory feedback would lead the child to raise his voice level above the surrounding noise, in order to monitor it. This in turn, contributes to the noise level around him and influences the voice levels of others. While the adult listener would discriminate speech sounds on the basis of contexual cues, probability, and decision making processes generally, speech hearing for the child may be more dependent on tne actual reception of speech sound than on its meaningful interpretation from contexual cues.

Arithmetic skills

Effects of noise on arithmetic skills in children have been studied. Kassinove (1972) investigated the effects of meaningful auditory stimulation on children's scholastic performance. Forty third-grade and forty sixth-grade elementary school children were the subjects. They worked independently on a series of self-paced addition or division problems, either in quiet or in the presence of several types of auditory stimuli namely, story, music and both combined. Task performance was evaluated in terms of meantime per response, variability of response time, probability of error, number of correct responses, number of "times-outs" and changes in these behaviours overtime. The results showed that the children were quite capable of performing at an adequate level in the face of various kinds of irrelevant auditory stimulation in the range of 70 to 80 dB SPL. There seemed to be little if any, effect of meaningful auditory stimulation on speed or on the accuracy of response.

Study of Kassinove (1972) supported Slater's (1968) study. Based on his study and from that of

Slater (1968), Kassinove (1972) suggested that schools should not go out of their way to try to sound-condition classrooms in an attempt to increase achievement.

This seems to indicate that while noises in excess of 100 dB SPL are detrimental to performance, noises in the range of 70 dB to 80 dB SPL, which subjectively seem intense but do not seem to cause performance deficit. Thus, moderate to loud noise appears to have no significant effect on the academic behavior.

Ishikawa and Aoki (1974) conducted an experiment concerning the effects of car noise on the performance of mental tasks. Eleven students were included as noise group subjects and an equal number of students were taken as controls. Three mental tasks were given in the experiment namely, successive multiplication, problem solving and four alternative reaction time tasks, in which the order of the stimulus appearance was arranged with zero or third order redundancy. The noise group was presented with tape recorded car noise of 80 phon SPL. It was expected that the noise level could have an interfering effect on any task tested. Results showed that noise interfered with the performance of each task to a certain degree. Immediately after the presentation of the noise, this interfering effect seemed strongest. The experimental group results posed the problem of adaptation to the noise.

Thus, it seems that the moderate levels of noise do not result in deficits in arithmetic skills. However, very intense noise levels might bring down the performance on arithmetic tasks.

Reading Comprehension

Noise can interfere with reading because it has some irrelevant cues in it or because it distracts the individual from the task at hand. Slater (1968) tested 263 (129 males and 134 females) seventh-grade public school children to determine the relationship of quiet and noise conditions to written task performance, requiring reading comprehension of short duration. Quiet (45-55 dB), average (55-70 dB) and noisy (75-90 dB) classroom and experimental conditions were used in the study. Noise in classroom condition was similar to that encountered by children during school activities. In the experimental condition white noise was used. It was hypothesized that subjects would perform better under quiet than under average and noisy conditions and that boys would be more adversely affected than girls. Results indicated a slight tendency for boys to work faster, but with less accuracy than girls under the unfamiliar condition of white noise. However, the magnitude of this tendency was not significant to be of any practical value. Effect of noise, neither detrimental nor beneficial, was demonstrated on speed or on accuracy of performance.

Supplemental data was obtained, by Slater (1968), following testing, by administering the Sarason Test Anxiety scale for children and questionnaires designed to assess subjects' perception of noise and their awareness of the purposes of the experiment. The subjects' perception upon their performance, the degree of noise which was present during the experiment, and the annoyance value of noise had little relationship to actual performance under the noise conditions used. Also, measured anxiety had little relationship to actual performance. The major body of data had strong evidence against any effect of noise under the specification of the experiment and upon the population used.

Slater (1968) concluded that at the junior high school level and possibly, at other grade levels, children's performance tested on written task, requiring reading comprehension, of the limited duration of class period in length is not affected either positively or negatively by the peaks of noise which were typical of a normal school environment.

However, Cohen, Glass and Singer (1973) studying the noise levels in home environment found a significant correlation between auditory discriminations and reading level and that noise adversely affected these two skills in children.

Noise levels found in school environment not only has effects on children but can also effect the teachers. Grosjean et al (1976) studied the influence of environment noises at various levels (45-75 dBA) on pedagogic efficiency in a group of eight pupils, 13 years of age and future teachers aged between 25 and 40 years. The results showed a nocivity threshold for the pupils at around 55 dBA and for the teachers at around 65 dBA. Further more, backward pupils were found to more adversely affected in this context from the interference of noise than advanced ones.

Effects of noise on the performance of handicapped children:

Children with learning disability, children who are backward or with language delay seem to be more adversely affected in task performance in the presence of noise than normally developing children. Grosjean et al. (1976) stated that backward pupils seemed to be affected more in the presence of noise than the advanced ones.

Glenn et al. (1978) surveyed the noise characteristics in residence of young mentally retarded children. The mean noise level was 75 dB SPL and the spectrum of the noise was similar to the longtime speech spectrum configuration. The investigators tested the effects of this type of noise on speech discrimination in these residents and compared the speech discrimination in quiet and in noise. The results showed a 73.9% word intelligibility as against 44% in noise condition. Glenn et al. (1978) concluded that these residents were possibly subjected to secondary impediment resulting from their living environment as they already have a primary language handicap.

Elliott (1979) reported that the children with learning problems performed more poorly on SPIN test than the normally developing children. Elliott, Kalikow and Stevens (1979) found that children with learning problems required higher signal intensities than the normally progressing children to achieve the 71% correct level of performance of understanding monosyllabic nouns.

From the above studies, it could be opined that when a child with language delay is placed in a normal classroom, he/she might have difficulty using auditory-based decision-making process necessary for functional language because of inadequate language experience. Such children would be more affected in speech discrimination tasks and perceiving sounds as meaningful in the noisy environment. Thus, children with language delay would find task performance impossible under noise levels acceptable to adult standards.

Noise not only affects the performance but also affects the physiological and psychological conditions of individuals. Sleep interference and annoyance are some of such effects studied.

Psychological effects:

The judged loudness and the annoyance caused by noise have received extensive study on adults. (Cohen et al. 1966; Kryter, 1968; Schultz, 1978; Broadhent, 1980). Very little is known about perceived noisiness in children.

Elliott (1971) studied noise tolerance and extroversion in children. The subjects were groups of children aged 5 and 10 years. Children aged 5 years to 5 years 11 months and 10 years to 10 years 11 months formed the two groups, with sixteen males and sixteen females in each. Extroverts showed a higher level of noise tolerance than introverts. Boys tolerated greater intensity noise than girls. There was no difference between the two groups in the level of noise tolerance. The lack of any difference between the 5 and 10 year olds, together with the lack of any sex and age interaction, suggested that developmental change in level of extroversion are minimal, at least beyond the age of 5 years. This study (Elliott, 1971) indicated that tolerance for noise depend in part with personality characteristics of the child.

Ishikawa and Aoki (1974) also observed that student's concentration was disturbed by noise. Lane and Meecham (1974) have stated that the school officials reported a significantly greater number of fights among the children in schools under the noise area than at the control schools.

Data available on psychological effects of noise in children are few. These do not allow for any definite conclusions.

Physiological effects:

Noises of sufficient loudness are found to affect the sleep, however, the different stages of sleep are differ entially affected by noise. The effect of acoustic signals on sleep of children has been studied. Ando and Hattori (1977) studied the reactions of babies to aircraft noise using Electroencephalography (EEC) and Electroplethysmography (PLG). The deep sleep of the babies was disturbed in noisy area above 95 weighted Equivalent continuous perceived Noise level (or 95 WECPNL).

Theissen (1978) studied the disturbance of sleep by noise in young adults, middle aged and old subjects using EEG. Based on the results, Theissen (1978) concluded that sleep experiments cannot yet be used in a definitive way as a criteria for setting night time.

However, whether these sleep disturbances are harmful or not and to what extent, are not known as the need for sleep itself is not understood. As Mills (1975) has stated that firm conclusions about the effects of noise on the sleep of infants and young children are not possible until the biological significance of sleep patterns and their dependent characteristics are understood.

In summary it could be said that the studies on the effects of noise in children have not yielded definite conclusions. Hearing loss due to noise exposure in children is still an open issue. However, Siervogel et al. (1982) reported data providing a strong evidence that the noise exposure in children is substantial.

Studies on speech discrimination in noise have consistently pointed out that children require higher S/N ratios than adults (Larson and Peterson, 1978; Elliott, 1979; Smyth, 1979; Houigast, 1981). Cohen, Glass and Singer (1973) have found that auditory discrimination deficits were observed in children exposed to noise for prolonged periods and this deficit was found to reflect poor reading achievement.

Children who are backward, children with learning disability or with language delay seemed to be more adversely affected in speech discrimination tasks by the presence of noise than the normally developing children. (Grosjean et al. 1976; Glenn et al. 1978; Elliott, 1979; Elliott, Kalikow and Stevens, 1979; Smyth, 1979).

The effects of noise on the performance of various other tasks have also been investigated. Studies of Slater (1968) and Kassinove (1972) did not show any adverse effects of noise on a written task, requiring reading comprehension and on scholastic performance respectively. Ko et al. (1981) also did not find significant long-term effect of noise on academic achievement in children. However, Lane and Meecham (1974) stated that the jet aircraft noise caused serious disruption of the concentration, communication and learning process necessary for educational activities.

Thus, the outcome of the studies on the effects of noise on scholastic performance in children have been equivocal. However, the presence of noise might adversely affect the reading skills in children. Reading comprehension involves complex perceptual and cognitive skills and the effect of noise on these skills has not been studied extensively, especially in the non-native language groups. Therefore the present study undertook to investigate the effects of noise on reading comprehension in children who are non-native speakers/listeners of English.

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CHAPTER - III

METHODOLOGY

The study was designed to see the effect of noise on reading comprehension in children.

Subjects:

Children in the age range of 9 to 12 years were the subjects. They were divided into three groups, each group consisting of twentyfour children, twelve females and twelve males. Group I consisted of children aged from 9 years to 9 years 11 months. Group II included children aged from 10 years to 10 years 11 months. Children of 11 years to 11 years 11 months age formed Group III.

The subject met the following criteria to be included in the study;

1. They had normal hearing in both the ears through air conduction in the frequency range of 250 Hz to 8000 Hz at octave intervals (ANSI, 1969).

2. They had an Intelligence Quotient (IQ) of at least 90 as tested on Seguine Form Board (SFB) test (a part of Pinter-Patterson Scale of intelligence 1917, from Cattell, 1953) and normal Developmental Quotient for their age as determined by using Developmental screening Test (Bharat Raj, 1977).

3. They had Kannada as their mother tongue and had knowledge of English.

4. They scored more than 50% in English in the previous class examination.

Materials:

Reading material:

Six short stories constituted the reading material. The stories were taken from popular children's magazines in English. On each passage, five questions were constructed. Of the five questions, two were of "fill in the blank" type and three were of "multiple choice" type.

These six stories were first given to 9 year old children (three females and three males) studying in English medium school on a trial basis. He/she was instructed to read the story carefully and understand. Following this the child was asked to answer the questions. Depending on their responses some of the questions which were reported to be ambiguous were substituted by other questions or put in a different form. This was done to make sure that even the 9 year old (the youngest group of the present study) children would be able to read and understand the passages and answer the questions. Also, depending on the responses, equivalence among the passages was determined.

The reading material namely six stories used in this study and the questions related to each are given in Appendixes.

Noise:

A "multi-talker babble" was used as the noise in the study. Since a child is exposed to speech of different languages as noise or as competing message in daily life situation, five languages Kannada, English, Hindi, Tamil and Malayalam were included for the recording of noise. A passage each from the above languages were read by the native speakers of the languages, except the English passage which was read by a non-native English speaker. Three talkers were males and two were females. Practice was given to the talkers to read together and to maintain the level of recording as monitored on the VU meter of the tape recorder.

Recording was done in a sound treated room, with all the talkers standing in a semicircle in front of the microphone at a distance of about two feet. Recording was done on a cassette tape using a cassette deck (Cosmic stereo cassette deck CO 88 X D) with an external microphone (Philips LKD 8202). The noise was recorded for a duration of ten minutes.

Average level of the noise was then determined using a Graphic level recorder (B&K 2305).

Deviations in peaks, if any, were within ± 2 dB with reference to the average level of the noise. A 1000 Hz calibration tone was recorded at the beginning of the tape at the average level of noise.

The level of noise emitted from the tape recorder at different volume settings was determined using a cassette tape recorder (Sony Cassette corder TC-95A) and the same tape recorder was used for collecting the required data. The noise level was measured using a sound level meter (B&K 2209), with a condenser microphone (B&K 4144) using a microphone adoptor (B&K DB0962 half inch to one inch). The measurements were made by keeping the tape recorder at a distance of three feet from the sound level meter kept directly in front of the microphone at the same level. Levels of noise emitted from the tape recorder were noted down for different volume settings of the tape recorder and 85 dB SPL at the 'third' volume setting was used for study.

Testing procedure:

To begin with, the subjects were screened for hearing and intelligence. A portable audiometer

(Maico MA 27) was used to test hearing. The audiometer was calibrated (ANSI, 1969) and only blue earphone was used for screening both the ears of each subject. The unused red earphone covered the non-test ear.

Intelligence was tested using Seguine Form Board test (a part of Pinter-Patterson Scale of Intelligence 1917, from Cattell, 1953). Developmental equotient was determined using Developmental Screening Test (Bharat Raj, 1977).

Subjects, who passed in the above screening tests were included in the study.

Reading comprehension for a given child was then tested under two conditions namely, quiet and noise. Each child was asked to read two passages, one in each condition. The passages to be read in quiet and noise conditions were chosen using random numbers. Half of the children in each group read in the quiet condition first and the other half read in the noise condition first, the conditions being randomized. Each of the six passages were read by equal number of children in each group.

Reading comprehension was tested in a quiet room in tne school. The tape recorder was kept at a distance of three feet from the child; directly in front of him/her. The tape recorder was kept at the level of subject's ear. The noise was presented from the tape recorder with the volume setting of "3" (the setting at which 85 dB SPL noise at a distance of three feet from the tape recorder was determined). In the quiet condition no noise from the tape recorder was presented.

Instructions given to the child for the 'quiet' condition was as follows: "I will give you an English story. Read the story silently. Read it carefully and understand. After you read the passage, I will give you some questions to be answered. The questions are related to the story you will read".

Instructions given for the child for the "noise" condition was as follows: "I will give you an English story. Read the story silently. There will be a noise coming out of the tape recorder while you are reading. Do not attend to the noise. Read the story carefully and understand. After you read the passage, I will give some questions to be answered. The questions are related the story you will read."

After instructing the child, he/she was given a typewriten passage. Time taken for reading the passage was noted down using a stop watch. After the subject read the passage, a typewritten question-cum-answer sheet was given. A time gap of about five minutes was given before administering testing in the second condition and the same procedure was repeated.

The answers to the questions were scored either correct or incorrect. Time taken for reading a given passage was noted in seconds for each child in both the conditions separately.

Scoring:

Each correct answer was given a credit of one score. The total score obtained for a given passage was then converted into percentage. Performance in each condition was found separately in terms of percentage. This served as an indicator of reading comprehension of a given child.

At the end of testing each child was asked whether the noise was disturbing him/her during reading. Subjective response of the child was noted down.

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CHAPTER - IV

<u>RESULTS</u>

The performance of the children on the reading comprehension task was analysed in terms of scores obtained by each subject in quiet and in the presence of noise. Also, the reading time was used as another measure.

The means and standard deviations were computed to find out the central tendency and variability of the scores and the reading time. Table 1 shows the means and standard deviation of the scores obtained by three groups on reading comprehension task in the two experimental conditions used. The means and standard deviation of the time in seconds and in minutes taken by the children are given in the Table 2.

The graphical representation of the means of scores and time taken for reading are given in Fig. 1 and Fig. 2 respectively.

Table 1: Table showing the means and standard deviations (S.D) of the scores obtained on the reading comprehension task.

GROUPS/ CONDITIONS	GROUPI		GROUP II		GROUP III	
	MEAN	S.D.	MEAN	S.D.	MEAN	S.D.
QUIET	58.4%	±29.39	71.6%	±27.64	74.2%	±24.14
NOISE	50.83	±29.99	68.2%	±27.03	76.6%	±22.82

Table 2: Table showing the means and standard deviations (S.D) of the time taken for reading in minutes (min.) and seconds (sec.)

GROUPS/ CONDITIONS	GROUP I		GROUP II		GROUP III	
	MEAN	S.D.	MEAN	S.D.	MEAN	S.D.
QUIET	135.75 sec.	±74.06	82.75 sec.	±36.59	83.58 sec.	±50.98
	2.26 min.	± 1.24	1.38 min.	±+ 0.61	1.39 min.	± 0.85
NOISE	113.29 sec.	±42.78	74.96 sec.	±36.95	91.49 sec.	±53.50
	1.89 min.	± 0.71	1.21 min.	± 0.53	1.48 min.	± 0.90

Table 3: Table showing results of ANOVA for the main effects of noise and age and their interaction (in terms of performance)

SOURCE OF VARIANCE	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARES	F RATIO
CONDITIONS (A)	00.69	1	0.69	0 .36
AGE GROUPS (B)	28.04	2	14.02	7,.38*
INTERACTION (AXB)	1.52	2	0.76	2 .50
WITHIN SETS	261.75	138	1.90	—
TOTAL	292.00	143		

* Significant at P< 0.01 level.

Table 4: Table showing results of ANOVA for the main effects of noise and age and thier interaction, (in terms of time taken for reading)

SOURCE OF VARIANCE	SUM OF SQUARES	DEGREE OR FREEDOM	MEAN SQUARES	F RATIO
CONDITIONS (A)	0.84	1	0.84	0.87
AGE (B)	16.66	2	8.33	11.41*
INTERACTIONS (AXB)	1.29	2	0.65	0.89
WITHIN SETS	100.96	138	0.73	
TOTAL	119.75	143		

* Significant at $P < 0.01$ level.

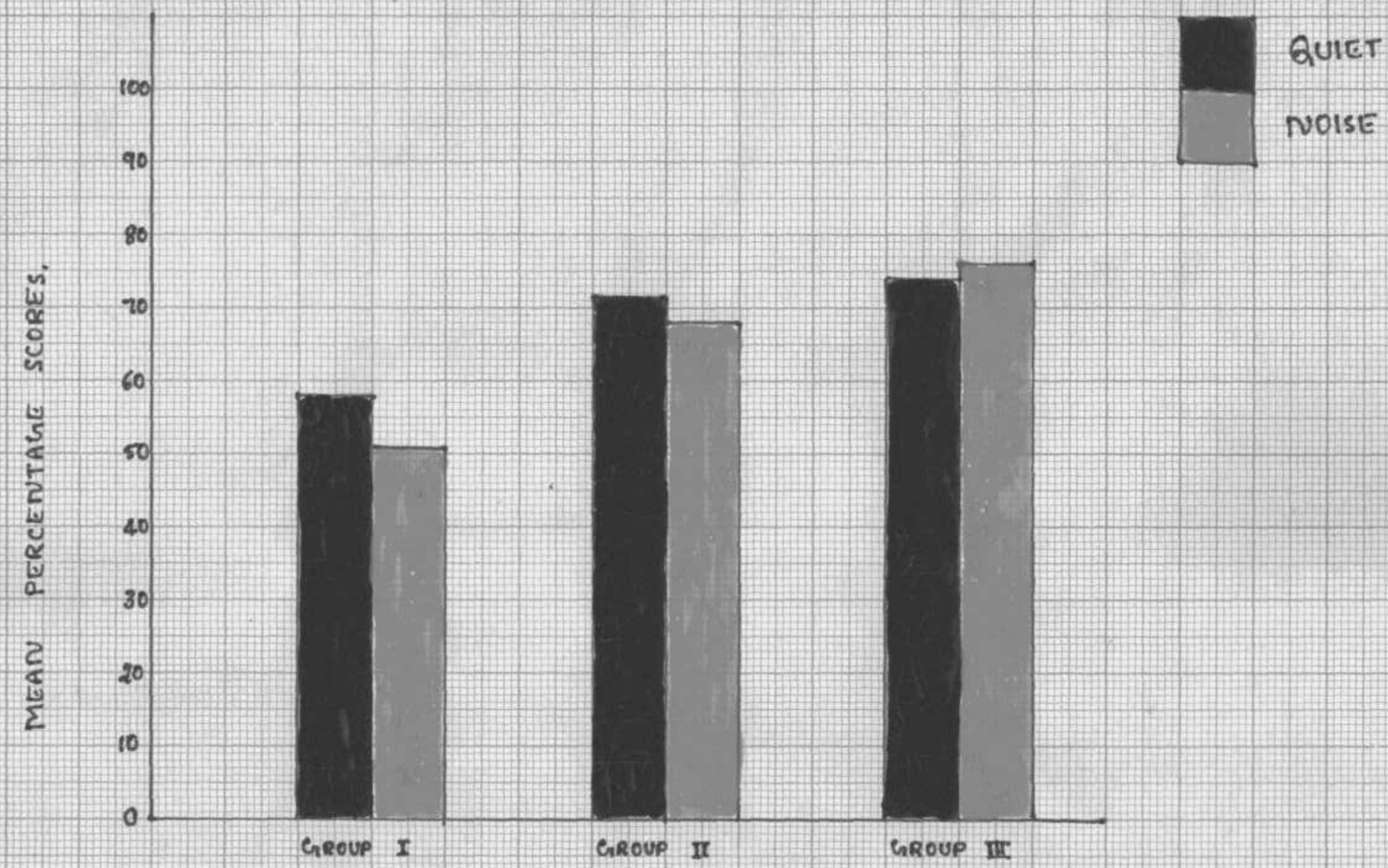

Fig 1: HISTOGRAMS SHOWING THE MEAN PERCENTAGE SCORES OBTAINED BY DIFFERENT GROUPS OF CHILDREN.
(in terms of performance)

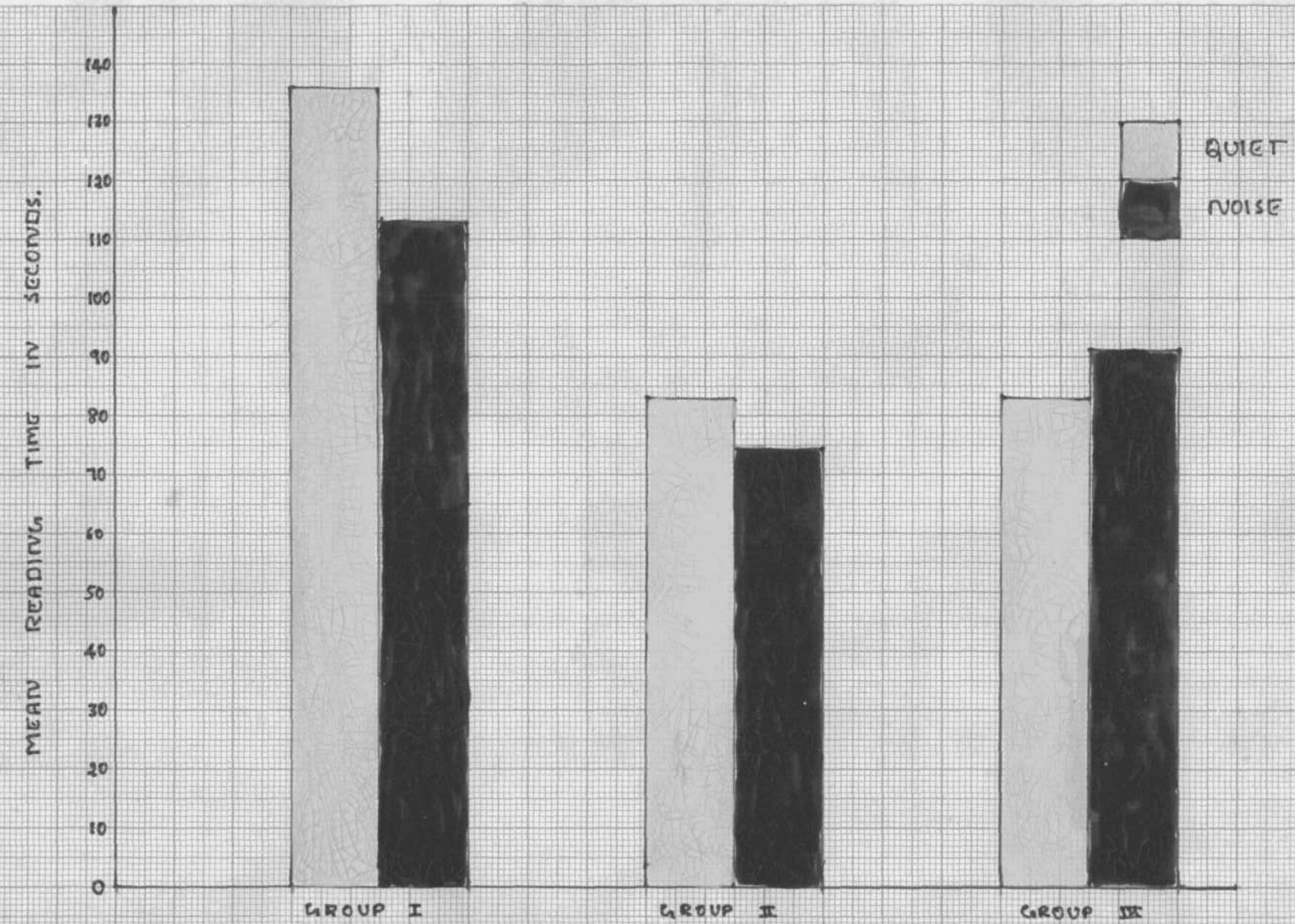

Fig 2: HISTOGRAMS SHOWING THE MEAN READING TIME (in seconds) TAKEN BY DIFFERENT GROUPS OF CHILDREN.

To findout if the main effects of noise, age and their interaction eifects were satisticalLY significant, two-way Analysis of Variance was applied. The results of ANOVA for the performance and reading time are given in Table 3 and Table 4 respectively.

The data on subjective responses towards the noise presented during testing indicated that 37.5% of the entire group found the noise to be disturbing. Five children in the Group I, eleven in Group II and eleven in Group III said that the noise disturbed them during reading in the study.

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CHAPTER - V

DISCUSSION

The results of the study indicate that the performance on the reading comprehension task increased with age. The mean scores obtained on the reading comprehension task, (Table 1), increased and the variability decreased with age in the two experimental conditions. In terms of reading time, children in Group II took lesser time than those in Group I. Group III took more time than Group II but lesser than Group I, in both the conditions of this study.

Effect of noise:

The two-way ANOVA showed that the changes in performance on the reading comprehension task, in the presence of noise was not satistically significant (Table 3). However, there was a slight reduction in performance of the 9 year and 10 year old children under noise and the performance of Group III children slightly increased in the presence of noise (Table 1).

Also, there was no statistically significant effect of noise on reading time (Table 4).

Children in Group I and Group II tended to read faster when noise was present but Group III children took longer time to read under noise (Table 2).

Group III children performed better under noise on the reading comprehension task and also took more time for reading under noise than in quiet. Thus, the improvement in performance is probably related to the fact that the children took longer time for reading and hence were more careful.

Children in Group I and Group II, on the other hand, took lesser time for reading under noise and performed poorer in the presence of noise than in quiet.

Effect of Age:

The F-ratio showed a satistically significant effect of age on reading comprehension. The performance improved significantly as the age increased in both the experimental conditions (Table 3).

Even in terms of the reading time, the effect of age was found to be significant (Table 4). Group I and Group II children took lesser time for reading in the presence of noise than in quiet. Group III took longer time for reading under noise than in quiet (Table 2).

Better performance in a reading comprehension task with increasing age is to be expected as the reading skills in children improve with growth and learning. Likewise, with increase in age children take lesser time to read a given passage.

Interaction effect:

The interaction effect of age and noise on the reading comprehension in terms of performance and reading time was not statistically significant (Table 3 and 4).

Thus, the major part of this study supports the findings of Slater (1968). In her study, a writing task was used to investigate the effects of noise in children. No noise effect, either detrimental or facilitating was demonstrated on speed or on occuracy of performance on a written task, requiring reading comprehension of short duration was found. However, in the present study, the writing aspect was not considered as a criterion of performance and the mistakes in spelling were not taken into account. The whole word response was considered in the 'fill in the blanks' type of questions and the 'multiple-choice' type did not require writing except putting a mark against the correct answers.

The findings of this study also agrees with the observations made by Kassinove (1972). He found that meaningful auditory stimulation namely, story, music and both combined, in no way affected the performance on scholastic tasks in children.

Thus, the findings of Slater (1966), Kassinove (1972) and the present one are in agreement in the observation that noise did not significantly affect the task performance in children. Despite the difference in methodology, the types of noise used and the tasks involved, the three studies indicate no significant effect of noise on the performance in children.

The lack of any significant effect of noise on the reading comprehension task or on time taken for reading in the present study is probably due to the fact that children are capable of ignoring the noise during reading and can concentrate on the task. This could be because the children are often exposed to hearing babble of voices in daily life situations and might be adapted to that type of noise.

Another explanation for this observation could be that the reading material in the present study was too simple and therefore did not require a great amount of concentration. In addition, the passages were of short length and did not require sustained attention on the part of the subjects. Therefore, the noise did not significantly affect the reading comprehension.

On the contrary, the results of speech perception under noise indicate that children require greater S/N ratio level to acnieve the performance level of the no-noise conditions (Larson and Peterson, 1978; Smyth, 1979; Houtgast, 1981). These differential effects are probably due to the differences in the modalities involved in the tasks tested. In case of speech perception in the presence of noise, both the stimuli and the distracting signal (noise) are processes through the auditory modality and hence a deficit might be expected. In cases ofproblem solving, reading or writing, the visual modality along with other mental and motor activities are involved and probably those tasks are not affected by the presence of noise, as the sensory modalities involved are different. Thus, it may be possible to ignore noise during reading.

Supplemental data:

The data obtained on the subjective responses towards the noise showed that eleven out of twentyfour children in Group II and Group III each, found the noise to be disturbing while reading. Only five of the twentyfour children in Group I found it so. In total, 37.5% of the entire group reported the noise to be disturbing while reading. However, the Group II children's performance showed slight decrement and Group III children showed slight improvement under noise. Therefore, the existence of a clear relationship between the subjective responses towards noise and the performance in noise is doubtful. Slater (1968) also reported that little relationship was found between the subjects' perception of the effects of noise and measured anxiety to actual performance.

In conclusion, it may be said that the "multi talker" babble used in this study had no significant effect on the reading comprehension of children aged between 9 and 12 years. Considering the observations made on the oldest group, it may be speculated that the older children tend to improve their performance under noise by taking more time for reading. However, this needs to be confirmed by further investigations using older children.

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CHAPTER VI

SUMMARY AND CONCLUSIONS

This study aimed at investigating the effects of noise on reading comprehension in children of different age groups, and the interaction effects of age and noise on the performance of reading comprehension task.

Children in the age range of 9 years to 12 years served as subjects. They were divided into three groups, each consisting of 24 children (12 males and 12 females). Subjects were tested in a non-native language namely, English and were native speakers/ listeners of Kannada. All had hearing within normal limits and were of atleast average intelligence.

Short stories taken from popular children's magazines in English constituted the reading material. Six such stories, which were approximately equal in terms of their difficulty level, were used. Five questions of similar types on each passage were constructed. The level of difficulty of the passages and the understandability of the questions were checked by assessing the comprehension of these passages of six 9 year old children.

Each subject was tested in two conditions namely, quiet and noise. The noise used was a "multi-talker babble" presented by means of a tape recorder at a level of 85 dB SPL. The testing was carried out in a quiet classroom in the school.

Each child was instructed to read a given story and then answer the five questions related to it. The answers to the questions were used as a measure of reading comprehension and also, the time taken by each child for reading a passage was noted down. Children were tested for reading comprehension in quiet and in noise conditions and thus, a given child read two stories. The conditions and the stories were randomized with each group. After the testing, the child was asked whether the noise presented during reading was disturbing or not and children's responses were noted down.

The results indicated no significant effect of the noise used in this study on the reading comprehension task in any of the age groups considered. The 11 year old children, however, performed slightly better in the presence of noise and took longer time to read.

There was a significant age effect ie., performance increased with age. No significant interaction effect of age and noise on reading comprehension was found. Only 37.5% of the entire sample reported the noise to be disturbing during reading.

Suggestions for future research:

1. Effects of noise on the reading comprehension could be studied in children of higher age groups.

2. Reading material of higher difficulty level could be used to investigate the effects of noise on reading comprehension.

3. The effects of noise on reading comprehension is non-native and native languages could be compared.

4. Different types of noise (for example, traffic noise) and noise of higher levels, could be investigated for their effects on reading comprehension in children.

5. Clinical utility of "multitalker" babble could be explored.

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REFERENCES

REFERENCES

Ando, Y and Hattori, H. Effects of noise on sleep of babies. J.Acoust. Soc. Amer. 62, 199-204 (1977).

Benigus, V.A., Otto, D.A., and Knelson, J.H., Effects of low frequency random noises on performance of a memeric monitoring task. Percept. Motor. Skills. 40, 231-239, (1975)

Bess, F.H and Poynor, R.E., Snow mobile engine noise and hearing. Arch. Otolaryngol. 95, 164-168, (1972).

Bharat Raj, J. Developmental screening test. Published by J.Bharat Raj. Mysore. 1977.

Broadbent, D.E., Noise in relation to annoyance, Performance and Mental health. J.Acoust. Soc. Amer. 68, 15-17, (1980).

Carhart, R., Tillman, T.W., and Greetis, E.S., Perceptual masking in multiple sound background. J.Acoust. Soc. Amer, 45, 694-703 (1969).

Cattell, R.B., Guide to mental testing for psychology clinics, schools and industrial psychologists. Third Edition. Univ. London Press, London (1953).

Chaney, R., Mc Lain, S., and Harrison, R. Relation of noise measurements to TTS in snow mobile users. J.Acoust Soc. Amer. 54, 1219-1223. (1973).

Cohen.A., Effects of noise on psychological state in D.W.Ward and E.J.Fricke (Eds.) Noise as a public health hazard ASHA. Rep.4, 74-88 (1969).

Cohen,A., Hummel, W.T., Turner, J.W., Dobos, F.N., and Dukes, M. Effects of noise on task performance. RR-4. U.S.Dept.of health, education and welfare. Public Health Service. Division of occupational health. (1966).

Cohen, D.C., Glass, D.S., and Singer, J.E. Apartment noise, auditory discrimination and reading ability in children. J.Exp. Soc.Psychol. 9, 407-422 (1973).

Donnerstein, E. and Wilson, D.W., Effects of noise and perceived control on ongoing and subsequently aggressive behavior J.Persa.Soc. Psvchol. 34, 774-781 (1976).

Eagles, E., Wishik, S., Doerfler, L., Melnick, W. and Levine, H, Hearing sensitivity and related factors in children. Laryngoscope, St Louis, MO. 220, 1963, in dsh abst. 4 abet.Kb.108, (1964).

Elliott, C.D., Noise tolerance and extroversion in children. Brit. J.Psvchol. 62, 375-380 (1971).

Elliott. L.L., Performance of children aged 9 to 17 years on a test of speech intelligibility in noise using sentence material with controlled word predictability. J.Acoust. Soc. Amer. 66, 651-653. (1979).

Elliott, L.L., Kalikow, D.N., and Stevens, K.N. Children's understanding of monosyllabic nouns in quiet and in noise. J.Acoust. Soc. Amer. 66, 12-22. (1979).

Falk, S.A and Farmer. J.C., Incubator noise and possible deafness Arch. Otolarynqol 97, 385-387 (1973).

Finkleman, J.Mand Glass, D.C. Reappraisal of the relationship between noise and human performance by means of a subsidiary task means J.Appl. Psychol. 54, 211-213. (1970).

Fior, R. Physiological maturation of auditory function between 3 and 13 years of age.Audiol. 11, 317-321, (1972).

Forster, P.M and Grierson, A.T. Noise and attention selectivity: A reproducible phenomenon? Brit. J.Psychol. 69, 489-498. (1978).

Gjaevenes, K. Measurements on the impulsive noise from crackers and toy fire arms. J.Acoust. Soc. Amer. 397, 403-404(1)X1966).

Glenn, L.E. et. al. Environmental noise in a residential institution for mentally retarded persons Amer.J. Ment. Defic. 82. 594-597 (1978) in dsh Abst. 19, abst. No.316, (1979).

Grosjean, L. et al. Noise and pedagogic efficiency in school activities. Experientia, 32, 575-576 (1976) dsh Abst. 16, abst. 2852 (1976).

Hartley, L.R and Adams, R.G. Effects of noise on the stroop test. J. Exp. Psycnol. 102, 62-66. (1974).

Hodge, D.C. and McCommons, B.M. Acoustied hazards of children's toys. J.Acoust. Soc. Amer. 911(B) (1966).

Hosey, A.D. Industrial noise: A guide to its evaluation and control. U.S. Dept.of Health, Education and Welfare. Public Health Service, Publication No.1572, (1967).

Houtgast, T. The effect of ambient noise on speech intelligibility in classrooms. Appl. Acoust. 14, 15-25, (1981).

Ishikawa, T. and Aoki, T. Effects of car noise on students' mental task. Bull. Fac. Educ. 20. 83-89 (1974) in dsh abst. 15, abst.No.1819. (1975).

Jeffregs, L.A. Masking in J.V. Tobias (Ed.), Foundations of modern auditory theory. Vol.1. Academic Press, New York. 85-114. (1970).

Jensen, P. Control of noise in the home in M.D.Lipscomb and C.A.Taylor (Eds.) Noise Control Handbook of principles and practices. Van Nostrand Reinold Co., 320-328, (1978).

Kalikow, D.N., Stevens, K.N and Elliott, L.L. Development of a test of speech intelligibility in noise using sentence materials with controlled word predictability J. Acoust. Soc. Amer. 61, 1337-1351 (1977).

Kassinove, H. Effects of meaningful auditory stimulation on children's scholastic performance. J. Educ. Psychol. 63, 526-530 (1972).

Key, K.F and Payne, M.C. Effects of noise frequency on performance and annoyance for men and women. Percept. Motor. Skills 52, 435-441. (1981).

Kb, N.W.M. et al. Effect of aircraft noise on pupil performance: A long term assessment. Appl. Acoust. 14, 399-402 (1981) .

Kryter, K.D. Concepts of perceived noisiness, their implementation and application. J.Acoust. Soc. Amer, 43, 344-361. (1968).

Kryter, K.D. The effects of noise on man. Academic Press. New York and London (1970).

Kryter, K.D. and Poza, F. Effects of noise on some autonomic system activities. J.Acoust. Soc. Amer, 67, 2036-2044. (1980).

Lane, R.S and Meecham, W.C. Jet noise at schools near Los Angeles International Airport. J.Acoust Soc. Amer. 56, 121-131 (1974).

Larson,G. and Peterson,B. Does noise limit the learning of young listeners. Elem. Sch. J. 33, 264-265 (1978) in dsh abst: 19, abst No.426 (1979).

Litke, R.E. Elevated high-frequency hearing in school children. Arch. Otolarynaol. 94, 255-257. (1971)

Maas.R.B, Industrial noise and hearing conservation in J.Katz (Ed.), Handbook of clinical audiology, Baltimore, Williams and Wilkins, First Edition, 772-818. (1972),

Marshall, L. and Brandt, J.F. TTS from a toy cap gun. J.Speech Hear. Dis., 39, 163-168. (1974).

Mathews, K.E., Jr. and Canon, L.K. Environmental noise level as a determinant of helping behavior. J.Pers. Soc. Psychol. 32, 571-578 (1975).

Miller, J.D. Effects of noise on people. J. Acoust. Soc. Amer. 56, 729-764, (1974).

Mills, J.H. Noise and children: A review of literature J.Acoust. Soc. Amer. 58, 767-779 (1975)

Nabelek, A.K and Nabelek. I.V. Noise control by acoustical treatment in M.D. Lipscomb and C.A.Taylor (E8s.), _Noise control-Handbook of principles and practices_ Van Nostrand Reinold Co., 150-158. 1978.

Neimoeller, A.F. Acoustical design of classrooms for the deaf. _Amen Ann. Deaf_. 113, 1040-1045 (1968).

Ogden, G.D. et al. Time varied noise effects on color-word test performance. _Percept.Motor Skills_ 49, 851-857 (1979).

0' Malley, J.J and Gailus. J. Noise and attention span. _Percept. Motor. Skills_, 44, 919-922 (1977).

Peltzman, P., Kitterman, J.A., Ostwald, P.F., Manchester, D, and Health, L. Effects of incubator noise on human hearing. _J.Aud. Res._, 10, 335-339 (1970).

Rai, S.N. Effects of environmental noises on estimation of duration. Percept. Motor Skills, 40, 338, (1975).

Roche, A.F. Longitudinal study of hearing in children: Baseline data concerning auditory thresholds, noise exposure and biological factors. J. Acoust. Soc. Amer. 64, 1593-1601, (1978).

Scharf, B. Critical bands, in J.V. Tobias (Ed.), Foundations of modern auditory theory, Vol.I, Academic Press, New York, 157-202 (1970).

Schultz, T.J. Synthesis of social surveys on noise annoyance. J.Acoust. Soc. Amer. 64, 377-405. (1978).

Siervogel, R.M. et. al. Longitudinal study of hearing in children II: Cross sectional studies of noise exposure as measured by dosimetry. J.Acoust. Soc. Amer. 71, 372-377. (1982).

Slater, B.R. Effects of noise on pupil performance. J.Educ. Psycnol. 59, 239-243. (1968).

Smyth, V. Speech reception in the presence of classroom noise. Lang. Speech. Hear. Serv. Schs. 10, 221-230. (1979)

Thiessen, G.J. Disturbance of sleep by noise. J.Acoust. Soc. Amer, 64, 216-222. (1978).

Warner, H.D. and Hemistra, N.w. Target detection performance as a function of noise intensity and task difficulty. Percept. Motor Skills, 36, 439-442. (1973).

Welch, B.L. and Welch, A.s. (Eds.) Physiological effects of noise, New York, Plannum Press, (1970)

Willeford, J.A. and Billger, J.M. Auditory perception in children with learning disabilities in J.Katz (Ed.) Handbook of clinical audiology, Baltimore, Williams and Wilkins, Second Edition, (1978).

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A P P E N D I C E S

"PROFIT"

Bhajan Das and Rajen Singh were enemies of each other. A Boxer came to live amidst them.

One day Bhajan Das took him aside and gave him hundred rupees and said, "Beat up Rajen Singh nicely."

Two days later Bhajan Das was returning from market along a lonely road. Then the Boxer saw him and hit him nicely.

"Wait! Wait!", screamed Bhajan Das for a full minute. Then the Boxer stopped beating and said, "I never thought of beating anybody. But you took me to be a goonda and gave me money. I told this to Rajen Singh and he gave me 250 rupees to beat you up. This was profitable, so I obliged to Rajen Singh. You can take back your money". He returned Bhajan Das's money and went away.

Questions on the story 'Profit'

A. Fill in the blanks

1. The new comer amidst Bhajan Das and Rajen Singh was

2. Bhajan Das gave__________ rupees to the Boxer.

35. Choose the correct answer and put a '✓' mark against it, for the following questions:

3. Whom did the Boxer beat?

    a) Bhajan Das
    b) Rajen Singh
    c) No one.

4. How much money did the boxer get in the end?

    a) 100 rupees.
    b) 250 rupees.
    c) 350 rupees.

5. Was it profitable to the Boxer in the end?

    a) Yes

II.

"THE UNCLE'S LABOUR"

There was a man living in a small village with his nephew. The nephew was a nice boy and helped his uncle at times.

One day, Govind was passing through that small village. It was morning. The wheels of his cart got stuck up in a pool of mud. He had to call the man who lived nearby hut for help. The man put his shoulder to rear of the cart and lifted and pushed the wheels out of the mud. Govind was pleased.

The man panting and sweating, extended his hand, in expectation of a reward. Govind paid him some money and said, "You must have grown tired!"

The man's little nephew, watching this, commented, "Naturally! Uncle was to carry jugfuls of water from the pond at night to keep the pool muddy, after all!"

Questions on the story "The Uncle's Labour".

A. Fill in the blanks:

1. ____________________ was passing through a small village.

2. The ________________ of his cart got stuck up in a pool of mud.

B. Choose the correct answer and put a 'tick ' mark against it, for the following questions:

3. Govind was pleased, because

   a) he saw a man

   b) he got a reward

   c) the man pushed the wheels of the cart out of the mud.

4. According to the man's nephew, the man was

   a) helping Govind selfishly

   b) cheating Govind

   c) working hard

5) The man was keeping the pool muddy by,

a) putting water into the pool from his house.
b) putting water into the pool from the pond.
c) bringing water from a nearby tap and putting into the pool.

III.

"NOBLE, BUT NOT WICKED"

A long line of ants was passing along the bank of a river nearby. A strong wind blew chotu, one of the tiniest ants, into the water.

A Dove, sitting on the tree near the river saw Chotu fall into the water. The good hearted bird dropped a leaf near Chotu. Chotu got on to the leaf and reached the bank of the river safely.

Some days later, a hunter came by. He saw the Dove and aimed an arrow at it. Chotu saw what the hunter meant to do. Chotu bit hard into the hunter's foot, and the arrow went off without hitting the Dove.

The hunter bent down and caught Chotu. He asked the ant angrily, "Why did you bite me?". Chotu replied politely, "Sir, I bit you, not to hurt you, but to save my friend, the Dove. He saved my life once".

The hunter was pleased and blessed Chotu. He said, "you are noble, my friend, not wicked."

Questions on the story "Noble, But Not Wicket".

A. Fill in the blanks:

1. Name of the small ant was

2. A strong ___________ blew Chotu into the water.

B. Choose the correct answer and put a ' ' mark against it, for the following question:

3. What did the Dove do wnen it saw Chotu fall into the water?

a) Dove threw a stone into the water.

b) Dove dropped a leaf into the water.

c) Dove dropped a feather into the water.

4. Did the hunter kill the Dove?

   a) Yes

   b) No

5. When the hunter was aiming at the Dove, Chotu

   a) kept quiet

   b) bit into hunter's foot

   c) watched the hunter kill the Dove.

IV.

"THE TWO LINES"

Gokul had two sons, named Ramu and Somu. When they were young, he once drew a small line on the wall and asked, "Boys, can make this line appear smaller without erasing a part of it?".

The boys admitted that they were unable to do it. Gokul drew a longer line parallel to the first one. "Does not the old line appear smaller now", he asked. The boys agreed, "Yes, it does".

After many years, Ramu and Somu got married. Gokul lived with Ramu. Ramu's wife maltreated him. So he went to live with Somu. Here not only Somu's wife but Somu also maltreated him.

So, Gokul came back to live with Ramu and told that Ramu and Ramu's wife were good to him. But Ramu told "No, father, you are not really happy. All that happened is, the old line appears smaller when compared with the new one."

Questions to the story "The two lines".

A. **Fill in the blanks:**

1. The names_of Gokul's sons are and ______________.

2. Gokul drew a________________line paraller to the first one to make it look smaller.

B. Choose the correct answer and put a 'tick ' mark against it for each of the following questions:

_3. Gokul lived with in the end.

a) Ramu

b) Somu

c) Both.

4. Gokul was happier with ____________

a) Somu and his wife.

b) Ramu and his wife.

5. According to what Ramu says in the end,

a) Gokul was not happy

b) Gokul was very happy

c) Gokul was neither happy nor sad

V.

"THE WISEST"

One day King of Vidarbha put a question to his courtcers and ministers. "Who is the wisest man? one who can answer will get a reward".

"You are the wisest man", one said.

"To say that much is not enough. You must prove what you say", said the king.

All kept quiet. But the Jester said, "My Lord, my father used to say that one who knows the answer to a particular question is the wisest man."

"What is the question", asked the King.

"The question is: what happens to one's soul immediately after death?" said the Jester.

Again, the King asked,"And what is the answer?"

"My Lord, I learnt the answer from my father. But I promised not to say it out", replied the Jester.

"You mean to prove that you are the wisest man", said the King.

"No, my Lord. I mean to prove that the King who has been able to keep a wiseman like me is the wisest man". The Jester won the award.

Questions on the story, "The Wisest".

A. Fill in the blanks:

1. Name of the kingdom was
2. The________________proved that the king was the wisest.

B. **Choose the correct answer and put 'tick ' mark against it, for the following questions:**

3. Who won the reward?

a) King
b) Jester
c) No one

4. The Jester did not answer the question, "What happens to the soul immediately after death? because

   a) he did not know
   b) he was worried
   c) he had promised his father not to say the answer to the others.

5. According to the Jester, King was the wisest man, because

   a) he was able to keep the wise men like Jester in the court.

b) there was no one in the court who wiser than the king.

c) he did not know the answer to the Jester's question.

VI.

"REAL AND SHADOW"

Dogs will play with boys and girls who do not throw stones, and other things at them. Tiger was a small dog, and village children loved him. They gave him bits to eat.

One day, Tiger got a large loaf of bread. He left with the loaf for his home in the village.

There was a river on the way. As Tiger walked along the bridge, he saw another dog. It was just like himself, with a large loaf of bread in his mouth, in the water.

Tiger wanted to snatch the other dog's loaf. He opened his mouth to bark and frighten the other dog. Alas .... the loaf in his mouth dropped into water. The fish in the river collected around the loaf and ate it.

How foolish Tiger was to want the loaf which only belonged to his shadow! It served him right to lose his real loaf!

Questions on the story, "Real & shadow":

A. Fill in the blanks:

1. There was a ____________________ on the way to Tiger's house.
2. Tiger saw his own ________________ in the water.

B. Choose the correct answer and put a 'tick ' mark against it, for the following questions:

3. Dogs like
   a) boys and girls who throw stones at them.
   b) boys who throw things at them.
   c) boys and girls who do not threw stones and things at them.

4. Tiger barked because,

a) boys threw stones at him.

b) he got frightened.

c) he saw another dog in the water.

5. How many loaves of bread did Tiger get in the end?

a) one loaf.

b) two loaves.

c) none.